

Acceleration Lab Report

Name _____

Date _____

DISCUSSION

1. a straight-line position, time graph indicates a _____ velocity.
2. a straight-line, horizontal position, time graph indicates _____ velocity.
3. a steep, position, time graph indicates a relatively _____ velocity.

PROCEDURE

I. Motion on an Incline

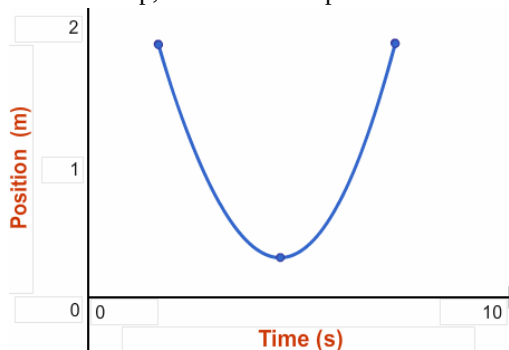
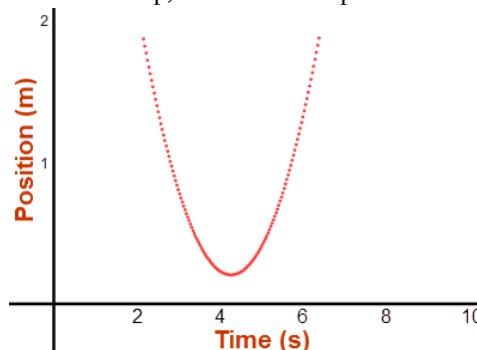
A. Position on an incline

1. Adjust your track to an angle between -2° and -6° . Your chosen track angle = $-\text{_____}^\circ$
2. Your chosen initial velocity, $v_o = \text{_____}$ cm/s
3. Approximately what is at the starting position, x_o , of the cart? _____ m
4. Approximately what is x_{top} ? _____ m Put one dot at $(t_{top} = 5 \text{ s}, x_{top})$.
5. Drawing lightly with your pencil, connect the points at 2 and 5 seconds with a straight line. Repeat for the points at 5 and 8 seconds. You should now have a nice, symmetrical, V. The slopes of the two lines would indicate two periods of constant velocity. Is that correct? No, the speed actually smoothly changes over time so the slope should also smoothly change. It should be steep when the speed is large, and horizontal when the cart is not moving. And it should never be vertical. What about the signs of the slopes? You learned about that in the velocity lab too. Add a smooth curve whose slope changes to match this pattern. Erase the V.
6. Describe the motion of the cart and the related shape your graph. You should use words like rise, fall, slow, fast, slowing down, speeding up, positive direction, negative direction, steep, $\pm$ slope.
 - a. For the trip up the ramp,

 - b. When the cart is at the top of the ramp,

 - c. For the trip back down the ramp,

7. Use the Sketch tool to create a screen-sketch of your prediction. You'll need to move the time axis to the bottom and make use of the Sketch curve tool.  Take a Screenshot, save it as "Accel_IA1a.png" and print out your figure. Attach it in the space provided.

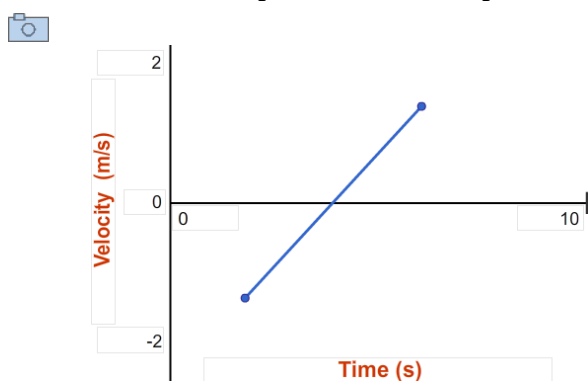
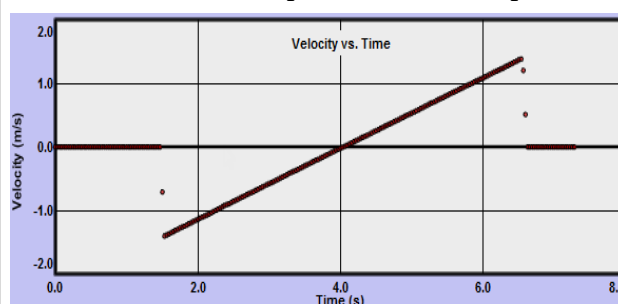
IA1a. Prediction: Up, then down ramp   IA1b. Observation: Up, then down ramp 

8. Now launch the cart with the Sensor on. Sweet! Draw the observed $x-t$ graph in Graph IA1b. (Omit the constant velocity periods.)

B. Velocity on an incline

1. The cart starts off traveling in a negative direction. Describe the cart's motion in terms of its changing velocity. Be sure to include the **direction of the velocity** which at a given instant will be **negative, positive, or neither**. Also include the **magnitude**, which will be **large** when the cart is going fast, **small** when it's going slowly, and **zero** when it's at rest.

2. Based on your description, draw your prediction of the shape of the velocity, time graph you'd expect in Graph IB1a.

IB1a. Prediction: Up, then down ramp  IB1b. Observation: Up, then down ramp 

3. Use Sketch to create a sketch of your prediction. Take a Screenshot, save it as "Accel_IB1b.png" and print out your figure. Attach it in the space provided.

6. Any surprises? It seems that the v - t graph should change when the cart gets to the top of the ramp, but instead it just keeps on rising. What about the v - t graph *does* change when the cart reaches the top?

7. Clearly describe your v - t graph. **Not the motion!** You should know the details we're looking for now.

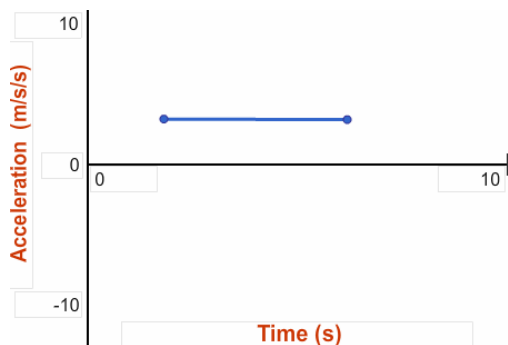
8. Consider the cart at the highest point it reaches along the track. Its velocity there is zero. Does it have this velocity of zero **for an instant** or **at an instant** at the top of its motion? Choose one of these two and explain your answer. (Look at your graph!)

C. Acceleration on an incline:

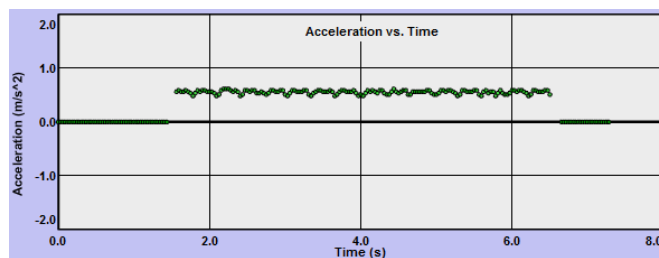
1. Look back at Table 1. How do we find acceleration from a velocity, time graph?

3. Draw Grapher's graph in Graph IC1b.

IC1a. Prediction: Up, then down ramp  



IC1b. Observation: Up, then down ramp 



4. Take a Screenshot of all three graphs using Screenshot in Grapher. Save it as "Accel_rampGraphs.png" and print it out to record the relationships among the three graphs. Attach it at the end of your lab.



You may have been surprised by what you saw. Shouldn't the acceleration be somehow different going up than going down, just like we saw with velocity? This is what was meant by the earlier remark – “You might say they use the same vocabulary but the words have different meanings.” The cart's *constantly* changing velocity is indicated by a *constantly changing slope* on an $x-t$ graph, a *constant slope* on a $v-t$ graph and a *constant value* on an $a-t$ graph!

Let's look at one other tricky, but important concept – **the meaning of the sign of the acceleration.**

For one-dimensional motion along a line (axis) we choose an arbitrary point where position is defined to be zero. Positions on one side of that point have negative values. Those on the other side have positive values.

5. When the cart is rolling up the ramp, its velocity is negative since it's moving in the negative direction. And the cart is slowing down.	The sign of its acceleration is _____
6. When the cart is rolling down the ramp, its velocity is positive since it's moving in the positive direction. And it's speeding up.	The sign of its acceleration is _____

7. Acceleration from acceleration, time graph ____ m/s^2

8. Acceleration from velocity, time graph ____ m/s^2

D. Find the acceleration due to gravity, g from the acceleration of our cart on an incline

1. Predicted maximum acceleration, $a_{\text{avg}}/\sin(\theta) = \text{_____} \text{ m/s}^2$

Show calculations here.

Compare this result to the value assumed in the lab, 9.80 m/s^2 by finding the percentage error.

2. Percentage error _____ %

Show calculations here.

E. The area under an acceleration vs. time graph

1. In the Examine box you'll see the time and acceleration (t, a) for that point. Doing the same with the right-most point you'll find your final time and acceleration for the trip. Record these values.

$$t_o, a_o = \text{_____} \text{ s}, \text{ _____} \text{ m/s}^2$$

$$t_f, a_f = \text{_____} \text{ s}, \text{ _____} \text{ m/s}^2$$

2. $\Delta v = \text{area under } a-t \text{ graph} = \text{_____} \text{ m/s}$

3. Now read v_o and v_f from the $v-t$ graph using the Examine tool. One problem. It has one extra data point on each end due to the way that the acceleration values are calculated. You've recorded t_o , and t_f above so you can use this to check that you're working with the right points.

$$t_o, v_o = \underline{\hspace{1cm}} \text{ s}, \quad \underline{\hspace{1cm}} \text{ m/s}$$

$$t_f, v_f = \underline{\hspace{1cm}} \text{ s}, \quad \underline{\hspace{1cm}} \text{ m/s}$$

$$\Delta v = v_f - v_o = \underline{\hspace{1cm}} \text{ m/s}$$

4. Compare your two values for Δv percentage difference.

Percentage difference = $\underline{\hspace{1cm}}$ %

Add your graphs and how calculations here.